DRAFT

DEFENSE INFORMATION INFRASTRUCTURE (DII)
COMMON OPERATING ENVIRONMENT (COE)

TRACK CORRELATION MANAGEMENT SERVICES

SOFTWARE REQUIREMENTS SPECIFICATION (SRS)

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1 Scope

1.1 Identification

This Document defines the Software Requirements Specification for a Defense Information Infrastructure (DII) Common Operating Environment (COE) Common Support Layer module designated as the Track Correlation Management Service.

1.2 System Overview

The Track Correlation Management Service is a COE Common Support Layer module. It is designed to provide both an automated and an interactive type of data management service known as correlation. Correlation is technically defined as the process of taking a new input (called a contact), comparing it to a database of previous inputs (called tracks), and deciding whether the new input is updated/revised information about an existing track or is a new, previously unreported input that should be added as a new record in the database. In this context, correlation includes front-end data conditioning, correlation, submission of new records for insertion, and combination of new inputs with existing database records to produce a new resulting record. In addition, user interaction with the data for analysis and maintenance is provided.

Correlation is not exclusively the domain of intelligence. Correlation is intended to be used by any process or mission application that maintains a resolved set of data that should be updated by new inputs. A non-intelligence example would be maintenance of a database of Global Positioning Satellite (GPS) transponder positions, updated in a dynamic fashion. Correlation of data from cooperative sources - ones that fully and uniquely identify the entities being tracked (like GPS) - could commonly be called "filing". Correlation of data from non-cooperative sources - such as enemy tracking reports - requires a more advanced approach, involving computational algorithms to process content within inputs as part of a decision making process.

Correlation is the first step of a larger process classically called data fusion, with the other steps being situational analysis, threat analysis, and processing refinement [JDL Data Fusion Model]. The intent of the Track Correlation Management Service is to provide automated support for correlation only; the requirements for the remaining levels of data fusion vary widely between the military services and should remain (at least for now) as mission applications.

Correlation is not the same as "common picture" or "battlefield visualization". It does share databases with those services, and it provides mechanisms for enforcing a common picture and permitting distributed contact data management across a theatre of operations. Ultimately, the Track Correlation Management Service provides a function that produces the "correlated" data set which can be used/viewed by its own display, manipulation, and data management services, or by any other COE segment/mission application desiring to use such data.

The following terms are employed throughout this document, working definitions are provided for completeness and for reference

ENTITY - a uniquely identified object (a unit, a piece of equipment, a person, a facility, a manmade feature, or a natural feature) that exists.

IDENTITY of an ENTITY - an attribute or a set of attributes that allow an entity to be uniquely specified and distinguished from other entities.

CONTACT - an observation of one or more attributes of an entity (whose identity may not have been among the contact's attributes).

TRACK - a set of contacts. A track inherits estimated attributes from the attributes of its constituent contacts. Contacts with the set may exhibit variable attribute values. ~~This document discusses a two tiered track structure - high level tracks that represent sets of contact reports that are assessed to correspond to a single entity, and low level, or reporting domain tracks, that share common parametric or attribute data. Low level tracks typically derive from a common reporting source and are often subject to domain specific correlation processing. It is always the case that a high level track may consist of the union of low level tracks that nonetheless retain their individual identities.~~

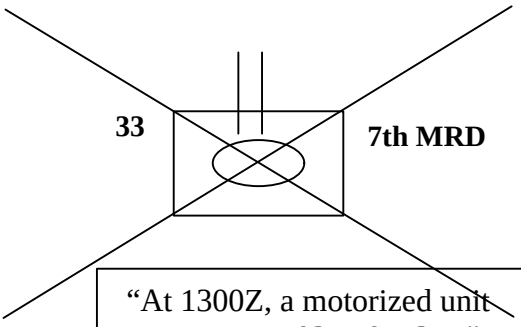
CORRELATION - the process of deciding whether a contact either belongs to an existing track or represents a new track (or may be ambiguous given available information).

CORRELATOR - the implementation of a correlation decision and the resulting database actions, either inserting a new record or updating an existing record.

ASSOCIATION - the process of linking an entity and a track; the determination of the identity of a track ~~(Editor's Note: This definition is not in concert with the definition of association held in the JDL DFM and classic data fusion texts which use the term assignment for the process of linking an entity and a track). -~~.

It is recognized that these definitions [except where noted] are similar to but not exactly the same as in the JDL Data Fusion Lexicon. The intent was to develop a working set of terms to provide a common reference for software system developers from all services; these definitions represent a consolidated proposal from the major service tactical intelligence system developers.

The following figure provides an illustration of these concepts.



An **entity** with its identity (33 MRB of the 7th MRD)

"At 1300Z, a motorized unit was seen at 5037N01234E"

"At 1320Z, a tanks and trucks was seen at 5038N01234E"

"At 1330Z, radio from the 33 MRB were heard near 5037N01236E"

Three **contacts**: C1, C2, and C3

Track 45	C1	C2	C3

A **track** made up of three contacts: C1, C2, and C3

Correlation is the decision to have C1, C2, and C3 belong to Track 45

Association is the process of linking Track 45 to the 33 MRB

1.3 Document Overview

This document is written to comply with MIL-STD-498, DI-IPSC-81433, the Data Item Description (DID) for a Software Requirements Specification (SRS). Paragraphs described in the DID that are not used in this particular document are identified with the corresponding DID paragraph number and title followed by the phrase "This paragraph has been tailored out.", per DID instruction.

Section 1 of this document provides introductory information that includes a system overview and document identification.

Section 2 of this document lists other documents referenced in this document.

Section 3 of this document describes the requirements for the system. Paragraphs not tailored out are as follows:

3.1 Required States and Modes: Directs adherence to DII COE states and modes..

3.2 Capability Requirements: Describes requirements of the system by capability (the bulk of this document).

3.3 External Interface Requirements: Describes required relationships with other entities that involve sharing, providing, or exchanging data.

3.4 Internal Interface Requirements: Describes requirements imposed on interfaces internal to ~~the~~ the system.

3.5 Internal Data Requirements: Deferred until software design process.

3.8 Security and Privacy Requirements: Describes requirements concerned with maintaining security and privacy.

3.10.1 Computer Hardware Requirements: Describes requirements regarding the computer hardware used by the system.

3.10.4 Computer Communications Requirements: Describes requirements concerning the computer communication that must be used by the system. Note that "communication" in this paragraph corresponds to communications between computers on a LAN/WAN and other ~~required~~ required networking features.

3.12 Design and Implementation Constraints: Describes requirements placed on system architecture or the use of some set of standards in development of the software.

Section 4 exists for the purpose of identifying methods used to qualify the software, e.g., test methods, etc. It has been tailored out.

Section 5 exists for the purpose of identifying requirements traceability. It has been tailored out.

Section 6 exists for the purpose of including additional notes that may help the reader in understanding the specification or to provide some other background information not included in Section 1. It has been tailored out.

Appendices are included as appropriate.

2 Applicable Documents

Battle Group Database Management Software Requirements Specification (BGDBM), SPAWAR-B-832, Revision A, Specification Change Notice 1, 1 March 1995.

MIL-STD-498, DI-IPSC-81433, Data Item Description for Software Requirements Specification, 5 December 1994.

JDL Data Fusion Model.

Track Correlation Management Services Functional Description Document ~~(FDD)~~, 17 July, 1996.

Defense Information Infrastructure (DII) Common Operating Environment (COE) Integration & Runtime Specification (I&RTS) , Joint Interoperability and Engineering Organization, Defense Information Systems Agency (DISA).

DII COE Baseline Document, v1.0, Joint Interoperability and Engineering Organization, DISA, 20 Feb 1996.

ORDs

3 Requirements

The following sections contain the detailed functional requirements for the Track Correlation Management Service. Throughout this document, this service is referred to as “the system”.

3.1 Required States and Modes

This service will adhere to the states and modes as defined for the DII COE.

3.2 Capability Requirements

Track Correlation Management Services functional requirements are focused on two goals: integrating contact data based upon discrete and continuous attribute information to create and maintain a valid and timely track database (Tdb), and support management of a common operational picture based on an allocation of data management responsibilities to organizations across a theater of operations. This section defines the system requirements to achieve both goals.

3.2.1 Data Representation Functional Requirements

3.2.1.1
The Tdb **shall** contain both contact and track data. This track and contact data **shall** be accessible in terms of related entities (e.g., aircraft, ships, land force units) and in terms of technical collection domains (e.g. ELINT, COMINT, ...). The Tdb will also contain associations between tracks and entities. (The mechanisms and internal data structures for implementation are not dictated in this SRS, nor are the number of contacts or tracks to be allocated.)

3.2.1.2
The system **shall** be capable of maintaining integrity of tracks within technical collection domains.

3.2.1.3
Identifying attributes and related information maintained for each of the Tdb tracks **shall** be based on that information needed to support the correlation processing requirements and to support display requirements, i.e. display symbol identification, location, and annotation.

3.2.1.4
The T~~DB~~db **shall** support representation of unit echelon and type (i.e. armored cavalry), and support association of units to represent aggregation into higher echelon forces.

3.2.1.5
Aggregated force representations **shall** include representation of the center of mass of the force and command post locations when known.

3.2.1.6
Associations between entities and tracks are intended to represent the results of a data fusion process and analysis. Associations, once established, **shall** also be capable of being broken (disassociated) in the event that contravening information becomes available.

3.2.1.7
The Tdb **shall** support the control of the visibility of each track across a LAN or WAN (referred to in this SRS as scope). A given track may be visible only at a given workstation on a LAN (terminal tracks), at all workstations on a local area network (local tracks), or be a candidate for transmission on a WAN (WAN tracks). The system **shall** support the assignment of track scope, and a mechanism for manually modifying the scope of a given track.

3.2.1.8
The Tdb **shall** support the designation of each record as either real world, live training (occurs when a friendly unit simulates a different object during a training exercise), and simulated (contact reports that are artificially injected into the system). Live training tracks **shall** be promotable to real world (with the required attribute changes) at the end of a training exercise.

3.2.1.9

The Tdb **shall** contain the most current attribute information for each track together with additional fields related to the track. The Tdb **shall** store all reports into the track's report history, but the track's report history may be limited to the most recent report events if required for disk management.
The size of archived track history may vary according to track characteristics. For example, there may be no requirement to archive unidentified TADIL track histories owing to the real time nature of the data source.

3.2.1.10
The Tdb **shall** support a scaleable, distributed environment across a LAN/WAN, be capable of maintaining a master Tdb for the network, and provide access to Tdb information across the LAN/WAN.

3.2.1.11
The system **shall** support the assignment to each track object of a unique identification (UID) key field that is guaranteed to be unique across the worldwide DII.

3.2.2 Correlation Service

The system **shall** provide the capability to automatically correlate incoming reports to existing tracks, originate new tracks when necessary, or originate ambiguities if correlation leads to anomaly. At a minimum, the system provides two types of correlation processing:

- Attribute correlation, wherein correlation decisions are based primarily on matching data fields with discrete valid values.

- Statistical correlation, which is applied in case the contact report contains useful continuous parameters characteristic of the entity being observed, but which contains insufficient discrete attributes for successful attribute matching.

This section specifies requirements for each type of processing, and how they should interact. It is organized along a model of data flow throughout the system with subsections devoted to data input and storage, data alignment, database update, correlation decision making, and data merging.

3.2.2.1 Data Input Interface and Storage

3.2.2.1.1
This system **shall** provide common APIs to accept contact data from other COE segments such as the Communications Services and Mission Applications.

3.2.2.1.2
The system **shall** support the encoding and decoding of high volume binary data streams to include TADIL A, B, J, and other high data rate inputs. This requirement is necessary to achieve the required throughput.

3.2.2.1.3
The system **shall** support the back-up and restoration of track histories by archiving track information. This capability **shall** provide track information during disk failure and system upgrades. The system **shall** preserve the data event by event. A batch update may result in data loss during system failure. The system **shall** down-sample high data rate inputs to ensure viable storage volumes.

3.2.2.2 Data Alignment

3.2.2.2.1

The system **shall** screen incoming contact reports for duplicate reporting and delete all contacts found to be an exact match to a previous report based upon attributes specified in a contact duplication table. (Note that this action could also occur at any time before the Tdb is updated and is not specified to occur in the data alignment phase.) Duplicate screening **shall** account for differences in reported precision, ret~~ai~~urning the most precise information when duplicates are detected.

3.2.2.2.2
The system **shall** validate and normalize incoming data and prioritize for subsequent processing.

3.2.2.2.3
Data normalization **shall** include renormalizing error ellipse to a standard confidence factor, and synonym aliasing where appropriate.

3.2.2.2.4
The system **shall** provide a data filtering capability on input based on operator specified criterion to either explicitly include or exclude contact reports from being further processed. The criterion **shall** include geographic location, timeliness, and other information (which may be collection domain specific) that is either explicitly reported in the incoming contact report information or implicit based on the reported information.

3.2.2.3 Distributed Data Management Functional Requirements

3.2.2.3.1
To support a Common Operational Picture (COP), the system **shall** support an allocation of data management responsibility by supporting the following modes of operation:

- Coordinator Mode - wherein a network node has been designated the responsible producer for compiling and maintaining a portion of the overall track database (e.g., based on geographic area, category, threat, track type) and reporting it in the form of track management directives both up echelon and to subordinate units.
- Participant Mode - wherein it ~~can~~**shall** accept the received track management directives of a coordinator to faithfully replicate the portion of the overall tactical picture.
- Independent Mode - wherein all necessary processing is performed at that system installation, without any received track management directives from any other processes.

This capability permits the system to function across a wide area network (WAN) as a participant in multiple coordinator's networks simultaneously, with the objective of integrating components of the overall consistent track database reported by those coordinators in accordance with the allocation of track management responsibilities (e.g., allocation of maintenance of the air, ground, and maritime components of the overall track database to the appropriate components, and / or, further allocating track management responsibilities based on geographic regions or other means). It follows that the system must be configurable to recognize authoritative external track management directives.

3.2.2.3.2
The system **shall** include the capability to allow the coordinator to issue track management directives which add, remove, and modify information in a participant's track database (e.g., change a previously reported identity from "Unit XYZ" to "Unknown" or a null / no statement value).

3.2.2.3.3
The system **shall** be capable of respecting track management directives from locally installed integrated mission applications which inject track data into the system (e.g., via standard APIs). Thus, a mission application can function as a virtual track coordinator for a designated subset of the track database.

3.2.2.3.4
In either the coordinator, participant, or multiple participant modes of operation described above, the system **shall** also be capable of integrating additional source data into the track database based on local information sources and injecting it in a manner consistent with the operating mode. (Note that the operating modes described above are not mutually exclusive. For example, the system may serve as a coordinator for a portion of the track database, while simultaneously functioning as a participant to multiple other coordinators to obtain their contributions to the overall theater tactical picture, as well as maintaining an independent view of selected portions of the track database.)

3.2.2.4 Correlation Processing

3.2.2.4.1
The system **shall** support routing of incoming data to the appropriate correlation processes. These processes **shall** include (but are not restricted to): discrete attributes, ELINT, COMINT, ACINT, GMTI, and others. The system **shall** be capable of directly updating the Track DB based upon received track management directives (e.g., receive track number, delete track, merge track), as well as maintaining an independent view of the data regardless of the system's operating mode (i.e., coordinator, participant, independent).

3.2.2.4.2
Whenever an incoming contact report contains data applicable to multiple correlation processes, the report **shall** be processed by each process. Decision rules **shall** be provided to resolve conflicts in the outcome of these multiple correlation processes. For example, a report that contains both unique attribute information and emitter parametric data **shall** be processed by both the attribute correlator and the ELINT correlator.

3.2.2.4.3
Attribute track correlation **shall** include feasibility checks, to include motion feasibility checks for moving targets and geographic tests for fixed targets. Feasibility tests **shall** include screening based upon category (land, naval, air, sub, etc.) and threat (friend, hostile, unknown, etc.) with a specified set of allowed and disallowed transitions. For land tracks, area delimitation **shall** be employed to refine the set of feasible track candidates.

3.2.2.4.4
Attribute matching **shall** be performed on a hierarchical basis to provide more reliance on higher confidence attributes and track continuity indicators, and ~~inhibi~~prevent inconsistencies in lower confidence attributes from preventing correlation in the presence of matching higher confidence information.

3.2.2.4.5
When updating Tdb objects based on correlation results, attribute information **shall** normally be treated as additive, with reported information being added to an object if not previously available but not over writing previously reported values so as to avoid allowing inconsistent reporting sources to incorrectly alter values in the Tdb. The exception to this additive update approach **shall** be the case of operating in participant mode wherein all updates from a coordinator will be treated on an over write basis, faithfully representing the coordinator's management of the subset of the overall tactical picture allocated to it.

3.2.2.4.6
Previously declared ambiguities **shall** be reprocessed on a periodic or event basis to attempt resolution.

3.2.2.4.7
Tdb management processing **shall** be configurable to automatically purge ~~unassociated~~ track objects based on specified auto purge criterion. Auto purge criteria **shall** include time, source and geo and **shall** permit

both inclusive and exclusive filters to be set. A track attribute **shall** be available that prevents autopurge from occurring.

3.2.2.4.8
The system **shall** support the ability to automatically associate tracks in the Tdb with entities within the Modernized Intelligence Database (MIDB). Processing of contacts **shall** be able to consider MIDB entities in the candidate selection process, where appropriate (such as SIGINT reporting).

3.2.2.4.9
The system **shall** not permit the correlation of contact reports with different scope or reality attributes. See sections 3.2.1.7 and 3.2.1.8.

3.2.2.4.10 The system **shall** permit the processing of time late data to support reconstruction and analysis.

3.2.2.4.10 ELINT Domain Processing

3.2.2.4.10.1
ELINT correlation **shall** be capable of exploiting apriori information about signal characteristics when available, but **shall** not be dependent on apriori information so as to be capable of processing unidentified reports or data about which little apriori information is available.

3.2.2.4.10.2
The ELINT correlation process includes assembling a set of tracks that are update candidates. Candidates **shall** be initially gathered based on matching or equivalent ELINT Notations (ELNOTs) or signal identification. In general, a precise match **shall** not be required except for cases where high confidence signal identifications are available. Multiple reported ELNOTs **shall** also be considered if contained in the incoming report.

3.2.2.4.10.3
ELINT candidates with matching or equivalent ELNOT or signal identifications **shall** be tested for motion or geographic feasibility, and for parameter feasibility.

3.2.2.4.10.4
ELINT correlation **shall** support Identification / re-identification processing to deal with known inconsistencies in reported ELNOT / signal identification data or unidentified reports.

3.2.2.4.10.5
For statistical correlation, the parameter feasibility screening (as well as all subsequent parameter processing) **shall** include explicit consideration of the accuracy of available parameter information, either explicitly reported by the information source or inferred based on the reporting source capabilities.

3.2.2.4.10.6
Candidates **shall** also be screened based on disregard time criteria. In processing both PRI and Scan information, baseband processing **shall** be applied.

3.2.2.4.10.7
Scoring and decision processing includes the actual evaluation of the reported parameter and geographic information against that contained in the candidate tracks. Reported parameter information (after basebanding) together with parameter stability / uncertainty information (reported or inferred) **shall** be scored against the estimated mean and estimated standard deviation (tolerance) for each parameter in each candidate ELINT track, and combined to form an overall parameter score for each candidate track.

3.2.2.4.10.8

The combination process **shall** include provisions for non-homogeneous overlap in parameters with different candidates (i.e. the common parameters between candidate "a" versus the report will not necessarily be identical to the common parameters between candidate "b" and the report).

3.2.2.4.10.9
Reported geographic information in the form of either an ellipse area of uncertainty at a specified containment percentage, or a line of bearing report and bearing uncertainty at a specified percentage containment **shall** be scored against the geographic information in the candidate track to form a geographic score.

3.2.2.4.10.10
In those cases where an emitter track is associated to a higher level tactical object, the geographic information for the higher level object **shall** be used for scoring (and all other geographic processing as well) since it represents the union of all geographic information available from all sources, not just geographic information available based on reports of that single emitter.

3.2.2.4.10.11
The geographic score and parameter score for each candidate track **shall** be combined into an overall score again using a self adaptive weighting process, and a decision made between updating one of the candidates, creating a new track object, or declaring an ambiguity based on an optimized minimum risk / cost of error criterion.

3.2.2.4.10.12
The system **shall** provide a ~~site~~ templating capability to support aggregation of ELINT track objects associated with a common function or mission such as weapons system, facility or platform..

3.2.2.4.10.13
Land based mobile ELINT processing **shall** also consider equipment breakdown and setup times in determining if an emitter has relocated

3.2.2.4.11 TADIL Domain Processing

3.2.2.4.11.1
The system **shall** be capable of simultaneously accepting an input from multiple TADIL sources to include both their updates and management directives, and replicating the TADIL tactical picture within the Tdb. The system **shall** be capable of accepting inputs from TADIL A, TADIL B, and TADIL J.

3.2.2.4.11.2
Correlation processing of TADIL data **shall** be focused on faithfully replicating the received track picture, and supporting it's integration within the overall tactical picture through association of TADIL tracks with higher level tactical object tracks.

3.2.2.4.11.3
The system **shall** be configurable to perform auto purge of Tdb contents and eliminate TADIL tracks which have ceased being reported.

3.2.2.4.11.4
TADIL processing **shall** be based primarily on received track numbers and management directives, but **shall** also include a secondary correlation scheme to reassociate data in the event that the link goes down and rapidly is reestablished, to automate the reassociation of TADIL tracks whenever possible in spite of block changes in TADIL track numbers associated with the link going down and back up.

3.2.2.4.11.5
Automatic association of TADIL tracks via PIF attribute matching **shall** be supported.

3.2.2.4.11.6
The system **shall** automatically resolve duplicate reporting of data received via multiple TADIL sources.

3.2.2.4.12 COMINT Domain Processing
Requirements to be provided at a later date.

3.2.2.4.13 ACINT Domain Processing
Requirements to be provided at a later date.

3.2.2.4.14 MTI Domain Processing
Requirements to be provided at a later date.

3.2.2.5 Data Merging

3.2.2.5.1
The system **shall** support the association and disassociation of reporting domain level track objects to primary high-level tracks. In this state, lower-level tracks continue to exist and are subject to continued updating by the appropriate correlation process, but the high-level track history represents the union of the histories of its lower-level tracks.

3.2.2.5.2
The system **shall** support the association of multiple low-level tracks to a single high-level track. For example, one of the lower-level tracks may be a Link track, another an ELINT track and a third a GMTI track. The system **shall** support the distribution of these high-low track relationships across a wide area network in order to maintain a common joint perspective.

3.2.2.5.3
Attributes not present in a high-level track **shall** be inherited from a low-level track. The high-level track's attribute **shall** prevail if there are conflicting values between a high-level and a low-level track. The system **shall** allow separation of associated tracks, with inherited attributes of each remaining after the separation.

3.2.2.5.4
The system **shall** support an Entity to Emitter Association database. The system **shall** support the addition, deletion and editing of data which lists particular emitters known to be associated with specific entities. The entity information **shall** consist of attributes such as entity name, entity class, entity type, entity identifying number, flag and entity control number. The emitter information **shall** include information such as the emitter name, ELNOT, and observed operating ranges for PRI, SCAN and RF.

3.2.2.5.5
The system **shall** include an automated capability to evaluate time position histories of similar and dissimilar (e.g. ELINT & Platform, ELINT & TADIL, COMINT & ELINT) source moving track objects, screen the available explicit or inferred attribute information on those track objects, and recommend associations of similar and dissimilar source tracks based on absence of conflicting attributes and the presence of unambiguous and statistically significant degrees of correspondence in the time position histories.

3.2.2.5.6
If a single contact report is subject to multiple correlation processes, and is simultaneously matched with

a high level track/entity and a lower level track, and no attribute conflicts result, then automatic association **shall** occur.

3.2.2.5.7
The system **shall** allow the merging of two tracks with non conflicting attributes into a single track record with a combined track history. In this case the two tracks lose their individual identity.

3.2.2.6 User Interaction Services

Requirements for user interaction with the correlation service are divided into database maintenance functions, search and query functions, ambiguity resolution support, data visualization services, and information broadcast maintenance.

3.2.2.6.1 User Maintenance of the Tdb

3.2.2.6.1.1
The system **shall** support the manual upgrade of a track from terminal to local (LAN) or WAN, but **shall** not support the downgrade of a track to a more restrictive category. A live-training track may be changed to a real-world track. However, a simulated track may not be changed to either a real-world track or a live-training track.

3.2.2.6.1.2
The system **shall** provide the capability to manage and list all technical data for a track. The system **shall** provide the capability of adding, merging, deleting, editing, associating objects and tracks, saving and restoring tracks and track information.

3.2.2.6.1.3
The system **shall** associate Access Control Lists (ACLs) with tracks in order to control read, write, update and edit access. The system **shall** accommodate explicit ACLs based, for example on geography. The system **shall** also support implicit ACLs based on user profiles. This access control **shall** apply to every account logged into the system.

3.2.2.6.1.4
The system **shall** allow the manual creation of a new one report track. Platform, ELINT tracks and acoustic tracks may be created in this manner. The system **shall** support the manual input of tracks that are shared between WAN activities, local to an activity's LAN, or restricted to a particular terminal. Track report types of position and line of bearing **shall** be supported.

3.2.2.6.1.5
The system **shall** allow entering, editing, or viewing any remarks about a selected track.

3.2.2.6.1.6
The system **shall** provide the capability to edit a track file. A track edit window **shall** be accessible from a pull-down menu or by double-clicking on the track's symbol or label as displayed on the tactical display. The track edit window **shall** contain data fields which identify the track (attribute fields) and which indicate its last reported position (last report fields). There may also be other data fields which further describe the track. The track edit window **shall** support different data elements, depending on the type of track being edited. These screens **shall** be dynamically updated and **shall** allow the selection of fields to be viewed and edited.

3.2.2.6.1.7
The system **shall** allow a track to be deleted from the system.

3.2.2.6.1.8
The system **shall** provide the capability to list the last 1000 history reports for a track and perform basic edit and delete options on any or all history points listed.

3.2.2.6.1.9
The system **shall** allow the generation of a printed summary report of track history information.

3.2.2.6.1.10
The system **shall** allow copying a history report from one track and paste it into the track history of another track.

3.2.2.6.1.11
The system **shall** provide a view of raw data for a selected track (if the latest report has been received through the Communication Service).

3.2.2.6.1.12
The system **shall** allow a "quick report" to be entered for a track. This **shall** consist of quickly bringing up a report form, entering appropriate report values, and saving the new report.

3.2.2.6.1.13
The system **shall** provide the capability to make a copy of a track file and then edit the attribute set to distinguish the two tracks.

3.2.2.6.1.14
When a track is copied, the designation of terminal, local LAN, or WAN **shall** be independent of the designation of the original track.

3.2.2.6.1.15
The system **shall** allow deletion of "selected" tracks from the track database with or without operator confirmation of each delete. Deletion of a track **shall** remove it from all track groups.

3.2.2.6.1.16
The system **shall** manage a database of autodelete rates (in minutes or hours) for ambiguities for all categories of tracks to include link air, link surface/subsurface, emitter and unknown tracks. The system **shall** support activation/deactivation of this feature. The system **shall** provide default, but modifiable, autodelete rates for each track category (naval, aircraft, land,…).

3.2.2.6.1.17
The system **shall** manage a database of up to 32 track groups for the purpose of tailoring a broadcast or tactical display . The system **shall** permit the addition, editing, or deletion of track groups.

3.2.2.6.1.18
Track group membership for both tracks **shall** be preserved during merge and delete management actions. When a master and slave track are merged, the resulting group membership **shall** be the union of the group membership for both tracks. Deletion of a track **shall** remove it from all track groups.

3.2.2.6.1.19
The system **shall** support projections of course and speed with four different algorithms. 1) The farthest out on the circle defined by speed, 2) the dead reckoned position calculated from most recent course and speed, 3) the smoothed filtered position base on MTST algorithm, and 4) the planned position based on the Movement Report.

3.2.2.6.1.20
The system **shall** provide context sensitive menus. It **shall** provide track options, including management, display and editing options, implicitly defined by characteristics of the track. For example, ELINT tracks and Link tracks will have different options.

3.2.2.6.1.21
The system **shall** support replay. An application **shall** be able to request a replay of the tactical situation between two time periods at any clock rate (real time, faster or slower). This data replay capability **shall** be private to the client or application that requested it. Playback **shall** be available by individual data sources. Playback **shall** be available from raw-data . Playback **shall** be available for track history for any tracks that survived and were archived. The system **shall** replay the information as merged/correlated and saved by the system.

3.2.2.6.1.22
The system **shall** be able to playback event by event live Link data for any 30 minute time period. The system **shall** provide a means to select this time period. The system **shall** support Link 4A (TADIL C), Link 11 (TADIL A,B), Link 14, and Link 16 (TADIL J).

3.2.2.6.1.23 Track Summaries
Track summary windows **shall** be available for all tracks, selected tracks, all ambiguities, ELINT tracks, ELINT ambiguities, selected ELINT tracks and acoustic tracks.

3.2.2.6.1.23.1
The system **shall** provide a dynamic track summary window including key attribute and position information about the tracks in the particular summary chosen. As new reports are received, any reports being viewed **shall** be update as the operator views them.

3.2.2.6.1.23.2
The system **shall** provide the capability to choose the columns and the display order for the summary from a master list of all available columns. The entries in the scrollable track summary window **shall** be color-coded according to their appropriate threat category.

3.2.2.6.1.23.3
From any summary window, the system **shall** allow to editing, deleting, or transmitting tracks.
The system **shall** allow the comparison of tracks from the summary and merging them together if appropriate. The system **shall** support the reprocessing, archiving and restoring of tracks from the summary.

3.2.2.6.1.23.4
The system **shall** provide a summary of the number of emitter tracks, the number of emitter ambiguities and the number of emitter tracks associated with a Platform tracks. The system **shall** also provide emitter track summary information. The summary **shall** include ELNOT, emitter name, local track number, the parent if the emitter track is associated with another track, track category, threat classification code, average PRI, SCAN and RF, number of reports received, the bearing and range from the current location and the amount of time elapsed since the last report.

3.2.2.6.1.23.5
As an aid in the resolution of ELINT ambiguities, the system **shall** provide a window describing the probabilities of various correlation hypotheses. This window **shall** act on any collection of candidate ELINT tracks and **shall** display the likelihood that a given reference track should be merged with a candidate or should create a new ELINT track. This window **shall** have the option of displaying the history points for the reference track and all candidate tracks, a parametric scatter plot display for all candidate tracks, and a parameter versus time graph for all candidate tracks.

3.2.2.6.1.23.6
The system **shall** provide the status of Link tracks, including the number of Link tracks in each Link network, plus detailed information broken down by Participating Unit. For each Link network, the system **shall** provide network cycle time and time of the most recent update. Information on Participating Units (PU) **shall** include PU number, PIF, Name of PU if merged with Intel track, link network name, number of air tracks reported by the PU, number of non-air tracks reported by PU, total number of tracks reported by PU, average track quality, number of duplicate tracks.

3.2.2.6.1.23.7
The system **shall** summarize the number of surface plus submarine tracks, the number of air tracks and the number of dropped tracks over the last eleven Link network cycles. A refresh capability **shall** support the update of this summary information on demand.

3.2.2.6.1.23.8
A summary **shall** also be provided for each PU to include local track number, PIF, track name if merged with Intel track, link name, track quality, track category, threat category, elapsed time since last update.

3.2.2.6.2 Database Search

3.2.2.6.2.1
A track search feature **shall** be provided to permit selective scans of the track database for candidate tracks matching the search criteria. Tracks which are found during a search **shall** become selected on the tactical display.

3.2.2.6.2.2
The system **shall** support a geographic track search. The capability **shall** include drawing a box, circle, or polygon on the tactical display and all tracks that fall within this area **shall** be selected. The system **shall** also provide the capability of selecting all tracks which fall outside, rather than inside the area.

3.2.2.6.2.3
The system **shall** support choosing a particular track and a range around the track as a geographic search area.

3.2.2.6.2.4
The system **shall** provide the capability to choose a predefined overlay as a geographic search area.

3.2.2.6.2.5
The system **shall** permit selective track database searches through attributes (such as track name, flag). The system **shall** allow entering known values for various attributes to find a group of tracks which have these particular attributes. Individual entries **shall** include wildcard (“*”) searches.

3.2.2.6.2.6
The system **shall** allow Boolean searches over combinations of attributes. The system **shall** also provide the capability to search for an operator-specified text string over all attribute fields.

3.2.2.6.2.7
The system **shall** provide a search capability available at any time during system operation. The tracks found in the search **shall** be added to the tracks currently selected.

3.2.2.6.2.8

A quick search capability **shall** be provided. The input **shall** consist of a one-line query, and any fields that match this entry from all the track attribute fields **shall** lead to selection of these tracks. This search **shall** have a one-time entry capability each time it is invoked.

3.2.2.6.2.9
The system **shall** store a group of search parameters (a search filter) which is maintained by the operator for selective activation and search.

3.2.2.6.2.10
A search to replace function **shall** be provided to enable changing one or more of the attributes for a track or a group of tracks. This **shall** allow a search of the track database and replace one or more of the attributes for all the tracks that are found with either blanks or with a new value.

3.2.2.6.2.11
A specific track search option **shall** exist to scan the database for tracks having duplicate values of an operator-selected attribute. When duplicates are found, a window **shall** appear which shows the specific duplicates detected and the number of tracks sharing this duplicate value. From this window, the system **shall** be able to run a comparison of the tracks and **shall** be able to merge tracks when appropriate.

3.2.2.6.3 Ambiguity Resolution Support

3.2.2.6.3.1
The system **shall** permit the storage, selection, and display of ambiguous tracks. These tracks can have track histories through the conventional correlation process or through operator entry and merge actions related to ambiguous tracks. Ambiguity resolution **shall** be the process of changing a track from an ambiguous track into either a new track or merging it with an existing nonambiguous track.

3.2.2.6.3.2
The system **shall** provide the capability to resolve ambiguous reports. The system **shall** allow the reports to be resolved to an existing track or to a new track.

3.2.2.6.3.3
The system **shall** provide the capability for track ambiguities to be manually resolved at the operator level. If an ambiguity resembles a track, but doesn't contain enough information for the system to correlate the report automatically, a candidate **shall** be created. For any candidate, the system **shall** provide a compare window to that displays the attributes of the two tracks to support a decision to merge the two tracks.

3.2.2.6.3.4
The system **shall** support changing an ambiguity into a new track, if appropriate.

3.2.2.6.3.5
The system **shall** support the manual and automatic reprocessing of ambiguities

3.2.2.6.4 Data Visualization

3.2.2.6.4.1
The system **shall** provide a tactical view to support track management. The system **shall** be able to distinguish tracks on the graphic display by track type(s). At the same time, the system **shall** be able to present this information in a temporal manner by source. For example, the first, fifth and sixth data points my result from ELINT tracks. The second and third may result from Link tracks. The system **shall** be able to manage this and display each source separately while maintaining the temporal nature of the data.

3.2.2.6.4.2
The system **shall** provide a history plot for a track and areas of uncertainty AOUs around track history points.

3.2.2.6.4.3
The system **shall** support centering a selected track on the tactical display.

3.2.2.6.4.4
The system **shall** support the activation and deactivation of the plotting of particular track types.

3.2.2.6.4.5
The system **shall** provide three ELINT scatter plots. This will include a plot of PRI vs. SCAN, PRI vs. RF and SCAN vs. RF for all contact reports in all candidate tracks if data is available. The system **shall** also provide plots of each ELINT parameter vs. Time for all contacts in all candidate tracks.

3.2.2.6.4.6
The system **shall** support multiple symbol sets, track leaders, Areas of Uncertainty, and labels (multiple colors, fonts) to include angled text (with and without angled characters). The system **shall** also provide symbol support using abstract font sets, bitmaps and dynamically constructed symbols using track attributes/characteristics.

3.2.2.6.4.7
The system **shall** support printing a summary of track database information for a selected track.
The system **shall** support a tabular listing of any set of selected tracks to be printed.

3.2.2.6.5 Information Broadcasts

3.2.2.6.5.1
The system **shall** allow the creation and management of broadcasts that allow organizations in a command hierarchy to synchronize their track picture. The system **shall** support the aggregation (roll-up) of information for higher levels in the command hierarchy.

3.2.2.6.5.2
The system **shall** allow a track coordinator to broadcast situation reports to participants. These reports **shall** contain the proper track numbers that are being used in coordination mode. This allows the participants to verify that their track picture is synchronized with the coordinator and investigate any discrepancies.

3.3 External Interface Requirements

Functionality of the database **shall** include transmission and receipt of messages via Communication Services/Data Exchange Services, and database maintenance via the Data Management Services. This functionality must exist for real-world, simulated, and live-training tracks.

3.3.1 Interface Identification and Diagrams

This paragraph has been tailored out.

3.3.2 Data Retrieval/Update Interface

3.3.2.1
Data sources **shall** include TADIXS, OTCIXS, RADAR, ACDS, JSTARS, PLRS/EPLRS, TRAP/TDDS, TIBS, TRIXS, SIPRNET, JWICS, IBS, and TADIL networks. The system **shall** support processing for national system reporting of tactical ballistic missile (TBM) and secondary imagery data.

3.3.2.2
The system **shall** provide the ability to choose a communications channel for transmission.

3.3.2.3
The architecture **shall** support high data rates and large amounts of data. It **shall** be scaleable. As such, no software changes and minimal system modifications **shall** be required to accommodate additional data sources or increases in data bandwidth.

3.3.2.4
The system **shall** support dynamically changing bandwidth availability in the backbone WAN.

3.3.2.5
The system **shall** track the sensor source at the report level. Any amplifying reports that are generated **shall** also display the source of the information, e.g., link network.

3.3.2.6
The system **shall** accommodate multiple tactical receiver data feeds.

3.3.3 External Segment Data Interaction

3.3.3.1
The system **shall** manage objects and additional information related to tracks, (e.g. overlays, PIMs and SOF/SORTS) and provide links to external applications such as MIDB. These links **shall** provide a path for the external applications to "related objects" with the server and request objects registered by another application. For Forces, the system **shall** maintain relationships between force structures and tracks and tie the tracks to the force distributions.

3.3.3.2
The system **shall** support the capability to query remote databases (such as JMIE, Wrangler) for information by vessel name, ID number, ID type, flag, time span, and geographical area. The system **shall** support the ability to select from a list of previously sent queries and to load those parameters.

3.3.3.3
The system **shall** support the viewing of track reports received from remote databases. The system **shall** support the comparison of these tracks and merging tracks that have identical track names and DTGs.

The system **shall** support the selection and addition of the tracks received from remote databases to the system track database.

3.3.3.4
The system **shall** provide correlation engine services to external applications.

3.3.3.5
The system **shall** provide a two way linkage between other segments and itself. This linkage will allow data sets to be filtered and distributed to the applications that need them, while maintaining access to the entire data set for every segment.

3.3.3.6
The system **shall** support APIs to permit mission applications to perform the following functions:

Submit a contact report to the correlation service.
Set event masks to request notification of specific correlation events (e.g. track update events or new track creation events).
Provide a user interface to manually modify selected track attributes.
Merge tracks.
Compare the attribute data in two or more tracks.
Delete selected track history points.
Delete tracks from the track data base.
Return the currently archived track history of a selected track.
Return all attribute data associated with a track.
Return all attribute data associated with any report in the track history.

3.4 Internal Interface Requirements

3.4.1
Within the COE, the track correlation management service has three primary internal interfaces, with communications, message processing and the tactical plotting components of Mapping, Charting Geodesy and Imagery (MCG&I). Correlation **shall** receive parsed data from the message decoding components of the COE on contact reports and track management directives for processing into the Tdb. Correlation **shall** provide data to message encoding components of the COE for formatting and transmission on contact reports and track management directives aimed at reporting and maintaining the COP.

3.4.2
Correlation **shall** make data in the Tdb available ~~to the~~for tactical plotting~~ area of MCG&I for geographic display~~ on top of MCG&I products.
The tactical display **shall** support the "selection" of Tdb objects by clicking directly on the track symbol or label.
An operator **shall** have the option of selecting a group of tracks in the same geographical area by dragging a "box" around them.

3.4.3
The Track Correlation Management Service requires~~ support from~~ communications and message processing services~~, to include support of~~ to support the encoding and decoding of high volume binary data streams to include TADIL A, B, J, and other high data rate inputs. This requirement is necessary to achieve the required throughput.

3.4.4
The COE should provide support for the aggregation of security label attributes (e.g., hierarchical classification, caveats, codewords, handling instructions).

3.5 Internal Data Requirements

These requirements will be determined during the software design process.

3.6 Adaptation Requirements

This paragraph has been tailored out.

3.7 Safety Requirements

This paragraph has been tailored out.

3.8 Security and Privacy Requirements

The system **shall** maintain classification and releasability information for reports, track attributes, and data source. This system **shall** be capable of operating in all security domains within the constraints of the security certification and accreditation process.

3.9 Environment Requirements

This paragraph has been tailored out.

3.10 Computer Resource Requirements

The system **shall** be compatible with the DII COE hardware platforms.

3.10.1 Computer Hardware Requirements

Throughput and performance of the Tdb and associated correlation processes **shall** be sufficient to maintain near real time performance with the data arrival rates capable of being presented across the external interfaces listed in section 3.3.2.1. This includes both the automatic correlation throughput, and the distribution across the LAN/WAN.

3.10.2 Computer Hardware Resource Utilization Requirements

This paragraph has been tailored out.

3.10.3 Computer Software Requirements

This paragraph has been tailored out.

3.10.4 Computer Communications Requirements

The system **shall** support the storage, management, and display of tracks that are shared between WAN activities across the battlespace, local to an organization's LAN, or restricted to a particular terminal.

3.10.4.1 Local Terminal

The system **shall** provide backup access to the Tdb server, and shared memory will be restored when necessary due to data loss.

3.10.4.2 Inter-DB synchronization

The system **shall** support two principle track management servers. In order to prevent loss of data in the event of a server failure, these databases must be synchronized; i.e. hot server backup.

3.10.4.3 Information Broadcasts

3.10.4.3.1
The system **shall** allow the transmission of selected tracks to another location using the Communication Service. All track types, including ambiguities, may be transmitted. The system **shall** permit either one track or a group of tracks to be transmitted.

3.10.4.3.2
When transmitting track reports, in support of COP processing, the system **shall** be able to support identifying the tracks by their local track numbers or by their Unique ID.

3.10.4.3.3
The system **shall** provide the option of sending the track data in compressed or expanded format. Compressed format reports **shall** contain additional information relevant to the individual track, while expanded format **shall** contain additional information.

3.10.4.3.4
The system **shall** provide the option to send history information with the track report or to send only the last reported position for the track. The system **shall** support sending only basic track information or an expanded set of information.

3.10.4.4 Information Alerts

3.10.4.4.1 Alert management
The system **shall** provide a centralized rule base to support track alert management. The concept is to remove the burden of identifying alerts from the clients and manage this task from the central server. Each application **shall** be capable of adding/inputting alert rules, the server **shall** identify them and alert the application of exceptions when they occur. Alerts may be overridden or augmented by mission applications.

3.10.4.4.2 Special Interest
The system **shall** provide a database that supports the generation of reports for tracks that are marked as being of special interest. The system **shall** maintain a status of "s~~uspect" and "nonsuspec~~pecial interest" for operator-selected tracks. ~~The designation of "suspect" will indicate that these tracks are of special interest.~~ This designation may be applied and removed by appropriate authorities in the network. An ALERT field in a track's edit window will be used to make this designation.

3.10.4.4.3
The system **shall** also provide a mechanism for transmitting the suspect/nonsuspect indication between activities via the Communication Service.

3.10.4.4.4
The system **shall** provide for identification of suspect tracks on the tactical display.

3.11 Software Quality Factors

This paragraph has been tailored out.

3.12 Design and Implementation Constraints

The system **shall** consist of a client-server architecture. Two versions of the primary server **shall** be supported on the same LAN with database commonality. This is necessary to support master-to-master data exchange. Two separate systems **shall** be capable of existing in two separate states and **shall** therefore utilize independent servers to support event by event communications on each.

3.12.1 Structure independent data access

The APIs **shall** be designed in a manner that supports longevity and compatibility. This **shall** be achieved through a design which creates and enforces a barrier between data structures and the calling application. The calling routine **shall** require no knowledge of the systems data structures.

3.13 Personnel-Related Requirements

This paragraph has been tailored out.

3.14 Training-Related Requirements

This paragraph has been tailored out.

3.15 Logistics-Related Requirements

This paragraph has been tailored out.

3.16 Other Requirements

This paragraph has been tailored out.

3.17 Packaging Requirements

This paragraph has been tailored out.

3.18 Precedence and Criticality of Requirements

This paragraph has been tailored out.

4 Qualification Provisions

This paragraph has been tailored out.

5 Requirements Traceability

This paragraph has been tailored out.

6 Notes

This paragraph has been tailored out.

A.1 List of Acronyms and abbreviations

ACDS	Advanced Combat Direction System
ACL	Access Control List
ACINT	Acoustic Intelligence
API	Application Programmer's Interface
AOU	Area of Uncertainty
BGDBM	Battle Group Database Management
COE	Common Operating Environment
COMINT	Communications Intelligence
COP	Common Operational Picture
DID	Data Item Description
DII	Defense Information Infrastructure
DTG	Date Time Group
ELINT	Electronic Intelligence
ELNOT	ELINT Notation
EPLRS	Enhanced Position Location Reporting System
GPS	Global Positioning System
IBS	Integrated Broadcast System
JMIE	Joint Maritime Intelligence Element
JSTARS	Joint Surveillance and Target Attack Radar System
JWICS	Joint Worldwide Intelligence Communications System
LAN	Local Area Network
MCG&I	Mapping, Charting, Geodesy, & Imagery
MIDB	Modernized Intelligence Database
MTI	Moving Target Indicator
OOB	Order of Battle
OTCIXS	Officer in Tactical Command Information Exchange Subsystem
PIF	Pseudo-Identification Feature
PIM	Path of Intended Movement
PLRS	Position Location Reporting System
PRI	Pulse Repetition Interval
PU	Participating Unit
RADAR	Radio Detection and Ranging
RF	Radio Frequency
SCAN	Scan Type Code
SIPRNET	Secret Internet Protocol Router Network
SOF	Status of Forces
SORTS	Status of Resources and Training System
SPAWAR	Space and Naval Warfare Systems Command

SRS	Software Requirements Specification
TADIL	Tactical Digital Information Link
TADIXS	Tactical Data Information Exchange Subsystem
TBM	Tactical Ballistic Missile
TDB	Track Database
TDBM	Track Database Manager
TDDS	Tactical Data Dissemination System
TIBS	Tactical Information Broadcast Service
TRAP	TRE and Related Applications
TRE	Tactical Receive Equipment
TRIXS	Tactical Reconnaissance Intelligence Exchange System
UID	Unique Identification
USA	United States Army
USAF	United States Air Force
USCG	United States Coast Guard
USMC	United States Marine Corps
USN	United States Navy
WAN	Wide Area Network